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Internet2 Musical Performance

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INTERNET2 MUSICAL PERFORMANCE

An Interactive Qualifying Project Report
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by

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Abstract

The high-speed Abilene network provided by the Internet2 consortium allows for a large variety of uses; it is the intent of this project to determine if the network can allow for musical ensembles to make use of the network to perform with other ensembles at other locations on the network in real-time.

Introduction

This IQP project is intended to address the question of whether the Abilene network provided by the Internet2 consortium can be used reliably for musical performances that involve groups from several locations on the network. The eventual hope is that the Abilene network could be used so that musical ensembles from WPI and other universities around the globe could perform in concerts without ever leaving their campus.

Background/Literature Review

Internet2 is neither a network nor a protocol as its name implies; it is instead a consortium run by over two hundred universities within the U.S. that work together with various industrial entities and government agencies to create and distribute new advanced network technologies. The University Corporation for Advanced Internet Development (UCAID) currently runs the Internet2 consortium. Its mission is to "facilitate and coordinate the development, operation and technology transfer of advanced, network-based applications and network services to further U.S. leadership in research and higher education and accelerate the availability of new services and applications on the Internet."

Procedure

For this project, we used the school's several TANDBERG teleconferencing units; two are (semi-)permanently located in Atwater Kent's conference room (218) and the other in Gateway Park's Seminar Room. The third unit is portable and was located in Alden Hall's Janet Earle room during our tests. The ATC also has a fourth unit that can be used as a bridge location but not as a call point within its TV studio.

Setup of the TANDBERG units is simple when only two are being used; as long as the IP addresses of both devices are known, all one needs to do in order to connect is to dial the IP address of one device from the other. For teleconferences using more than two devices, a "bridge" must be used to connect all of the devices to a single conference.

In order to gain access to the TANDBERG equipment and conference rooms, reservations had to be made with the ATC, the ECE department and Gateway Park. Each week before the scheduled conference time, the portable TANDBERG unit would be picked up at the ATC and moved to the Janet Earle room in Alden. There, it would be plugged in to the school network using ethernet. Members of the Vocal Performance Lab (VPL) were then split up into two groups; one would move to Atwater Kent for the duration of the test and the other would remain in Alden.

Setting up the equipment in Atwater Kent involved turning on a large television as well as the room's TANDBERG unit; an omni-directional microphone had to be plugged into the podium where the camera unit was located.

In the case of two-way conferencing with only the portable unit and the Atwater Kent room, the portable unit would then dial the IP address of the unit in Atwater Kent, at which point the conference would start. For three-way conferencing, staff in the ATC used the unit in their TV studio to call all of the participating TANDBERG units and link them together.
After setup was completed, testing began. The conductor(s) first chose a song that had been prepared earlier by the students in the VPL, and then would conduct the students through one or more verses of the song. The conductor would continue conducting the students through the music a number of times, each time trying something slightly different, such as changing the tempo of the song or which side of the conference would be conducting.

After testing was done, cleanup consisted of ending the call from one end or the other and turning off all the equipment. The portable TANDBERG unit would be packed up in Alden and then brought back to the ATC until the next week.

Results

Various combinations of student grouping and placement were tried over the course of the project. The majority of tests involved only two locations on campus: the Janet Earle room in Alden Hall, and room 218 in Atwater Kent. One test made use of a third location in Gateway Park's Seminar Room.

Early two-way tests provided a number of consistent results:

- While the students on the non-conducting end of the connection were able to follow the conductor and other singers well, they appeared to be between half a second to a full second behind when observed from the conductor's side.
- Occasionally the system would emit loud bursts of static in Atwater Kent. This did not occur in Alden with the portable unit. The bursts of static became less frequent as the project continued.
- In general, the smaller group in Atwater Kent usually found it easier to follow the large group in Alden than the other way around.
- Changing the tempo of the song affected how far the non-conducting group was ahead of the conducting group. Whether faster or slower tempos worked better depended on the song(s) being sung.

Additional results from the three-way tests that included the Gateway Seminar Room:

- For whichever group was conducting, the other two groups appeared to be more or less in sync with each other.
- For each of the two non-conducting groups, the other group often appeared behind by about a beat.
- Increasing the tempo resulted in some odder delays -- three quarters of a beat off instead of a whole beat -- while decreasing the tempo seemed to help the groups stay more in sync with the conductor.
- Occasionally one or more ends of the conference would experience a "stutter" where their sound would stop being broadcast temporarily.

Analysis of Results

Many of the issues that were encountered during testing were unavoidable and could not be fixed through action on the part of anyone participating in the test. In particular, the appearance of the non-conducting group(s) as being almost a second behind the conducting group was a result of the TANDBERG units needing to encode/decode the video and audio before transmitting it across the network -- not the actual transmission between units, which was almost instantaneous. The occasional bursts of static appeared to disappear after a few rounds of testing. During the three-way conference, the occasional "stutter" that occurred was most likely an anti-interruption mechanism intended to prevent different parties from talking over one another.

Smaller groups attempting to follow larger groups may have worked better due to the increased ease in 'sensing' the beat and place due to the larger group's better ability to blend together. The reverse likely did not work as well because the larger group would have had to pick out the smaller group from over their own voices.

The best results occurred when the conductor was in one location and those singing were at any other location except for that of the conductor, but only from the point of view of the conductor and anyone else present at that location. This was most likely due to the delay in transmission; anything received at one location from another occurred between one quarter and one half of a second before it was received. Even with one location specifically designated as "conductor only", as the number of locations with singers increases, so does an "echo" effect that can be observed at those locations.

* How well did each group/combination work?
* Did they match expected results?

Conclusions and Recommendations

It is my belief that while it might be feasible to use this system for performances by various musical ensembles, the amount of time and effort required to set up an event that only uses facilities located on the WPI campus makes it prohibitive. To combat this, I would suggest several things.

First, public online schedule-viewing for all of the facilities where the TANDBERG units reside, and the ability to reserve one or more facilities via the web as opposed to simply sending an email to the appropriate secretary or visiting the department office. Being unable to reserve one or more locations from a single location makes it difficult to find times where all necessary rooms and/or equipment are available for use.

Second, the WPI administration needs to supply funds to replace the broken equipment in the Fuller Access Node located in the lobby of Daniels and Morgan. The non-functional state of this equipment severely hampered the progress of this project, necessitating the use of a portable unit for the duration of the project. Because the portable unit needed to be picked up every week and brought to Alden, this meant that

time that would otherwise have been spent running tests was spent running back and forth across campus making sure everything was set up properly.
* Suggested changes to system?
* Workarounds for issues encountered?

Bibliography

WPI Information Technology Division - Internet2. 25 Feb. 2005. Worcester Polytechnic Institute. 16 Nov. 2008 <http://www.wpi.edu/Admin/IT/Internet2/>.

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